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NOTE ON THE HELIOTROPISM OF PALÆ- MONETES LARVÆ.

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The striking peculiarity of the light reaction of these larvæ is that they orient themselves with the anterior end away from the light and then swim backward toward the light. If orientation alone is the criterion of a tropism, these organisms are negatively heliotropic. But they gather on the side of the disk toward the light and as ordinarily observed would surely be considered positive.

Blue light produces these effects as strongly as daylight. Red light is almost ineffective.

The orientation of the larvæ is usually extremely precise. The instant that light is admitted to a dish containing the larvæ, they all turn so that their heads are directed away from the source of light and the body axis is in the line of the rays. In many the abdomen is strongly extended so that the body axis is a straight line. These swim backward practically in a straight line. Very frequently they swim on their backs in a perfectly straight course to the light side of the dish. Others swim with ventral side directed down.

Besides the individuals which hold their bodies extended and exhibit very accurate orientation there are many which swim with the abdomen more or less flexed ventrally. These are inclined to rotate, but their general course is quite exact toward the light.

A study of the water currents, when India ink was added, showed that the backward movement was the result of strong forward beats of the swimmerets. The details have not been studied. The animals can move forward, but this form of locomotion is quite different from the backward type, being accomplished by a series of very rapid jumps or plunges. So quick were these forward movements that I could not accurately observe how they were accomplished. I believe that they were

due to strong extension of the tail, the animal first bending the body ventrally and then suddenly extending it. The jumping reaction occurred on strong stimulation of any kind : for example, on throwing light suddenly into the dish. The orientation with the head away from the light was accomplished by one or more leaps, but so accurately that one could hardly speak of trial and error. When the animals in swimming backward toward the light suddenly hit any obstruction, the springing reaction carried them momentarily away from the light. But they immediately began, under the influence of the swimmerets, to move backward toward the light. So it would often happen that on reaching the side of the vessel the larvæ would strike, jump away, swim back, jump away again, and so on many times without losing their orientation in the direction of the light rays.

It was therefore of some interest to know how these larvæ would behave if the sense of response to light could be reversed. I have made only a beginning of this study.

The effects of raising the temperature were not clear. For the most part the leaping reaction predominated. The animals darted rapidly about and lost their orientation to light.

Better results were obtained by diluting the sea water. If the larvæ were placed in a mixture of 50 c.c. distilled water and 100 c.c. sea water, a considerable proportion of them went to the negative side of the dish. This they did without changing their orientation. In other words they now employed the forward instead of the backward type of locomotion and thus arrived at the side of the dish away from the light. Often there seemed to be a conflict between the two methods of locomotion, the animals oscillating back and forth like shuttles, but always with the heads away from the light. Equal quantities of distilled and sea water gave even more pronounced results.

The responses were not always so regular and machine-like as I have described. Some of the more pronounced "negative" individuals moved by an irregular, mostly sidewise motion away from the light. Taken as a whole the "negative" effect secured by diluting the sea water was less precise and definite than the "positive" reaction. Also most of the "negative" individuals were only temporarily so.

On returning negative individuals to the undiluted sea water they at once swam to the light side of the dish, but without changing their orientation, *i. e.*, with head directed away from the light.

The question of nomenclature which these observations suggest may well await further investigations. The experiments here recorded were made at the Marine Biological Laboratory at Woods Hole.

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